

June 30, 2006

Mr. Christopher M. Crane, President
and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BYRON STATION, UNIT NOS. 1 AND 2 - EXEMPTION FROM THE
REQUIREMENTS OF 10 CFR 50.44, 10 CFR 50.46, AND 10 CFR PART 50,
APPENDIX K (TAC NOS. MC8517 AND MC8518)

Dear Mr. Crane:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.44, 10 CFR 50.46 and 10 CFR Part 50, Appendix K, for Byron Station, Unit Nos. 1 and 2. This action is in response to your letter of September 23, 2005, which submitted a request for an exemption from the aforementioned regulations. The exemption allows the use of up to four lead test assemblies containing fuel rods with AXIOM™ cladding.

A copy of the exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Robert F. Kuntz, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454 and STN 50-455

Enclosure:
Exemption

cc w/encl: See next page

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Byron Station Units 1 and 2

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
EXELON GENERATION COMPANY, LLC
BYRON STATION, UNIT NOS. 1 AND 2
DOCKET NOS. STN 50-454 AND STN 50-455
EXEMPTION

1.0 BACKGROUND

The Exelon Generation Company, LLC (Exelon, licensee) is the holder of Facility Operating License Nos. NPF-37 and NPF-66 which authorize operation of the Byron Station Unit 1 and Unit 2, respectively. The licenses provide, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC, Commission) now or hereafter in effect.

The facility consists of two pressurized-water reactors located in Ogle County, Illinois.

2.0 REQUEST/ACTION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.12, “Specific exemptions,” Exelon has requested an exemption from 10 CFR 50.44, “Combustible gas control system for nuclear power reactors”; 10 CFR 50.46, “Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors”; and Appendix K to 10 CFR Part 50, “ECCS Evaluation Models.” The regulation at 10 CFR 50.44 specifies requirements for the control of hydrogen gas generated after a postulated loss-of-coolant accident (LOCA) for reactors fueled with zirconium cladding. Section 50.46 contains acceptance criteria for ECCS for reactors fueled with zircaloy or ZIRLO™ cladding. Appendix K

to 10 CFR Part 50 requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction.

The exemption request relates solely to the specific types of cladding material specified in these regulations. As written, the regulations presume the use of zircaloy or ZIRLO™ fuel rod cladding. Thus, an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR Part 50, is needed to irradiate lead test assemblies (LTAs) comprised of the AXIOM™ developmental clad alloys at Byron Station, Unit Nos. 1 and 2.

3.0 DISCUSSION

3.1 Material Design

3.1.1 Fuel Material Design

In order to meet future demands of the nuclear industry, Westinghouse is evaluating the in-reactor performance of several developmental alloys. The licensee states that the material properties and mechanical performance of the advanced cladding alloys are expected to be similar to Zircaloy-4 and ZIRLO™, and that any difference in phase transition temperatures and mechanical strength will be considered in the LTA fuel rod design evaluation. Further, preliminary autoclave testing indicates that the advanced alloys exhibit acceptable corrosion resistance. This is consistent with the NRC staff's expectation that unirradiated properties of any advanced cladding alloy will be accounted for in the LTA fuel rod design evaluation.

The licensee's September 23, 2005, letter stated:

The current licensed fuel performance code predictions for the developmental cladding will be compared to post-irradiation examination data at Byron Station. If significantly adverse observations are found relative to predictions, the adverse rod(s) will either be removed and the fuel assembly will be reconstituted with suitable replacement rods, or the entire fuel assembly will be removed from the following fuel cycle(s) until deviations are understood and addressed.

Where appropriate, concurrent data obtained from other LTA programs for the same developmental claddings will be factored into the assessment of the LTAs at Byron Station. Specifically, before the assemblies are reinserted, all available information will be reviewed to ensure existing design assumptions remain valid.

Based upon the limited number of advanced alloy fuel rods placed in non-limiting core locations, specifically accounting for significant deviations in unirradiated material and mechanical properties, and an LTA post-irradiation examination program aimed at qualifying model predictions and understanding deviations, the NRC staff finds the LTA mechanical design acceptable for Byron Station Unit Nos. 1 and 2.

3.1.2 Core Physics and Non-LOCA Analysis

The exemption request relates solely to the specific types of cladding material specified in the regulations. No new or altered design limits for purposes of 10 CFR Part 50, Appendix A, General Design Criterion 10, "Reactor design," need to be applied or are required for this program.

The standard reload methodologies will be applied to the advanced cladding alloys. Nuclear design evaluations will assure that LTAs will be placed in non-limiting core locations. As such, additional thermal margin to design limits will be maintained between LTA fuel rods and the hot rod evaluated in safety analyses. Thermal-hydraulic and non-LOCA evaluations will confirm that the LTAs are bounded by the current analysis of record.

Based upon testing to date it is not anticipated that any of the advanced cladding fuel rods would fail during normal operation. However, if any failures occurred, their effects would be well within technical specification limits for doses and, in all cases, core coolable geometry would be maintained. The NRC staff agrees that the placement of a limited number of advanced alloy fuel rods in non-limiting locations would not challenge reported dose consequences nor core coolability.

Based upon the limited number of advanced alloy fuel rods placed in non-limiting core locations, the use of approved models and methods, and expected material performance, the NRC staff finds that the irradiation of up to four LTAs at the Byron Station will not result in unsafe operation nor violation of specified acceptable fuel design limits. Furthermore, in the

event of a design-basis accident, these LTAs will not promote consequences beyond those currently analyzed.

3.2 Regulatory Evaluation

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present.

3.2.1 10 CFR 50.44

The underlying purpose of 10 CFR 50.44 is to assure that means are provided for the control of hydrogen gas that may be generated following a LOCA. The licensee has provided a means for controlling hydrogen gas and has previously considered the potential for hydrogen gas generation stemming from a metal-water reaction. Based upon the material composition of these alloys, which is similar to other licensed zirconium alloys, the high temperature metal-water reaction rates are expected to be similar. Due to the limited number and anticipated performance of the advanced cladding fuel rods, the previous calculations of hydrogen production resulting from a metal-water reaction will not be significantly changed. As such, the limitations of 10 CFR 50.44 related to cladding material is not necessary for the licensee to achieve the underlying purpose of the rule in these circumstances.

3.2.2 10 CFR 50.46

The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance in response to LOCAs. Due to the limited number of advanced alloy fuel rods, any change in the post-LOCA ductility characteristics of the advanced alloy fuel rods (relative to the 2200 EF peak cladding temperature and 17 percent effective cladding reacted) would not challenge core coolable geometry. Westinghouse performs cycle-specific reload evaluations to

assure that 10 CFR 50.46 acceptance criteria are satisfied and will include the LTAs in such analyses. Thus, the limitations of 10 CFR 50.46 related to cladding material are not necessary for the licensee to achieve the underlying purpose of the rule in these circumstances.

3.2.3 10 CFR 50, Appendix K

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rates of energy, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of the rule would not permit use of the equation for the advanced cladding alloys for determining acceptable fuel performance. Based upon the material composition of these alloys, which is similar to other licensed zirconium alloys, the high temperature metal-water reaction rates are expected to be similar. Because of the limited number of AXIOM™ clad fuel rods and the similarity in material composition to other advanced cladding fuel rods, the NRC staff concludes that the application of the Baker-Just equation in these conditions is acceptable. Thus, application of 10 CFR Part 50 Appendix K, Paragraph I.A.5 is not necessary for the licensee to achieve the underlying purpose of the rule in these circumstances.

3.2.4 Special Circumstances

In summary, the NRC staff reviewed the licensee's request of proposed exemption to allow up to four LTAs containing fuel rods with AXIOM™ cladding. Based on the NRC staff's evaluation, as set forth above, the NRC staff considers that granting the proposed exemption will not defeat the underlying purpose of 10 CFR 50.46, 10 CFR 50.44, or Appendix K to 10 CFR Part 50. Accordingly, special circumstances, are present pursuant to 10 CFR 50.12(a)(2)(ii).

3.2.5 Other Standards in 10 CFR 50.12

The NRC staff examined the rest of the licensee's rationale to support the exemption request, and concluded that the use of AXIOM™ would satisfy 10 CFR 50.12(a) as follows:

- 1) The requested exemption is authorized by law:

No law precludes the activities covered by this exemption request. The Commission, based on technical reasons set forth in rulemaking records, specified the specific cladding materials identified in 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K. Cladding materials are not specified by statute.

- 2) The requested exemption does not present an undue risk to the public health and safety as stated in the licensee's exemption request:

The LTA safety evaluation will ensure that the acceptance criteria of 10 CFR 50.46, 10 CFR 50.44, and 10 CFR 50 Appendix K are met following insertion of the assemblies containing AXIOM™ material. Fuel assemblies using AXIOM™ cladding will be evaluated using NRC-approved analytical methods and will address the changes in the cladding material properties. The safety analysis for Byron Station Units 1 and 2 is supported by the applicable Technical Specifications. The Byron Station Units 1 and 2 reload cores containing AXIOM™ cladding will continue to be operated in accordance with the operating limits specified in the Technical Specifications. LTAs using AXIOM™ cladding will be placed in non-limiting core locations. Therefore, this exemption will not pose an undue risk to public health and safety.

The NRC staff has evaluated these considerations as set forth in Section 3.1 of this exemption. For the reasons set forth in that section, the NRC staff concludes that AXIOM™ may be used as a cladding material for no more than four LTAs to be placed in non-limiting core locations during Byron's next refueling outage, and that an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K does not pose an undue risk to the public health and safety.

- 3) The requested exemption will not endanger the common defense and security:

The common defense and security are not affected and, therefore, not endangered by this exemption.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants Exelon an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR Part 50, Appendix K, for Byron Station, Unit Nos. 1 and 2.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (71 FR 32144).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 30th day of June 2006.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Catherine Haney, Director
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation